



5743 - Spotlighting the ionised Universe by uncovering the faintest ever host galaxy of a Fast Radio Burst

Cycle: 3, Proposal Category: GO

INVESTIGATORS

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Dr. Marcin Glowacki (CoI) (ESA Member)	University of Edinburgh, Institute for Astronomy
Ms. Yuanming Wang (CoI)	University of Sydney

OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
Imaging of the FRB Field				
	1	NIRCam Imaging	NIRCam Imaging	(1) FRB20210912A
NIRSPEC spectroscopy of the FRB Host				
	2	NIRSpec spectroscopy of host	NIRSpec Fixed Slit Spectroscopy	(3) FRBHost

ABSTRACT

Fast Radio Bursts (FRBs) are millisecond duration radio transients that originate at cosmological distances. Because the ionised intergalactic medium (along with the circumgalactic and interstellar media in both the host galaxies and the Milky Way) leads to a frequency dependent delay in their arrival time on the order of seconds, the electron column along an FRB line of sight can be measured to 0.1% or better, meaning they can be used as precision probes of the ionised Universe - including the elusive diffuse components. The current record holder is a recently-identified FRB from redshift 1, but other bursts exhibit frequency dependent delays consistent with an origin at even higher redshift. Of these, just one - FRB 20210912A - has been localised sufficiently precisely for follow-up, and yet no host has been seen in deep ground-based imaging at this location - to a limit 3 magnitudes fainter than any of the dozens of other known FRB host galaxies! Modeling indicates that the host of FRB 20210912A is likely a faint galaxy at $z \sim 1.3$, and will be infeasible to detect with ground-based facilities. With a modest JWST imaging and spectroscopy program, we can detect the host of this FRB, confirm its record-breaking redshift, and use it to 1) support (or refute) the neutron-star magnetosphere model for FRB progenitors, and 2) extend the relationship between FRB dispersion and redshift, refining the prospects for using FRBs to determine both cosmological parameters such as the Hubble constant and the impact of galaxy feedback on the distribution of ionised baryons.

OBSERVING DESCRIPTION

This proposal seeks to identify the host galaxy of FRB 20210912A, which has been shown by existing ground-based photometry to be at least ~ 3 magnitudes fainter than the faintest known host of a Fast Radio Burst (FRB) and is very likely at redshift > 1 (but cannot be higher than 1.8, based on the observed frequency-dependent dispersion of the FRB introduced by the ionised intergalactic medium). To do so, we will use NIRCAM photometry to identify all sources in the vicinity of the FRB localisation above a limiting Ks band magnitude of ~ 28.5 , which would include any known FRB host galaxy out to a redshift of at least 1.8. Having identified the host galaxy via this NIRCAM pre-imaging, we will follow with a single NIRSPEC slit observation placed on the host (and oriented to cover either a nearby galaxy, or else the site of the FRB if that is offset from the galaxy centre) to identify the host redshift and characterise its properties.

Proposal 5743 - Targets - Spotlighting the ionised Universe by uncovering the faintest ever host galaxy of a Fast Radio Burst

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	FRB20210912A	RA: 23 23 10.3940 (350.7933083d) Dec: -30 24 19.86 (-30.40552d) Equinox: J2000	Epoch of Position: 2000	
<p><i>Comments:</i> <i>Category=Unidentified</i> <i>Description=[Blank field, Radio sources, Variable radiation sources]</i> <i>Extended=YES</i></p>				
Fixed Targets	(2) Offset_pointing_star	RA: 23 23 9.7491 (350.7906213d) Dec: -30 24 9.75 (-30.40271d) Equinox: J2000		
	<p><i>Comments: Updated 9/11/2024: updated with an actual star from the NIRCAM image</i></p> <p><i>Originally: This is a placeholder source known from existing VLT imaging of the FRB 20210912A field at Ks band - its position will be refined (or an alternate offset WATA acquisition source will be chosen) after the NIRCAM pre-imaging observations are completed.</i></p> <p><i>Category=Star</i> <i>Description=[M stars]</i> <i>Extended=NO</i></p>			
(3)	FRBHost	RA: 23 23 10.4328 (350.7934700d) Dec: -30 24 19.46 (-30.40541d) Equinox: J2000		
<p><i>Comments: Updated 9/11/2024: updated with the most likely position of the FRB host from the NIRCAM image</i></p> <p><i>Category=Galaxy</i> <i>Description=[Compact dwarf galaxy]</i> <i>Extended=YES</i></p>				

Proposal 5743 - Observation 1 - Spotlighting the ionised Universe by uncovering the faintest ever host galaxy of a Fast Radio Burst

Mon May 19 13:00:09 GMT 2025

Observation	<p>Proposal 5743, Observation 1: NIRCam Imaging</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRCam Imaging</p>									
Diagnostics	(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.									
Fixed Targets	#	Name	Target Coordinates			Targ. Coord. Corrections		Miscellaneous		
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	<p><i>Comments:</i> <i>Category=Unidentified</i> <i>Description=[Blank field, Radio sources, Variable radiation sources]</i> <i>Extended=YES</i></p>									
Template	Module		Subarray			Target Placement				
	ALL		FULL			Module Gap				
Dithers	#	Primary Dither Type		Primary Dithers		Subpixel Dither Type		Dither Size		Subpixel Positions
	1	INTRAMODULEX		4		SMALL-GRID-DITHER				1
Spectral Elements	#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID
	1	F200W	F322W2	MEDIUM8	6	2	8	4	5024.808	172118
Special Requirements	<p>Aperture PA Range 24.92542306 to 59.92542306 Degrees (V3 25.0 to 60.0) Offset 125.0 arcsec, 35.0 arcsec</p>									

Proposal 5743 - Observation 2 - Spotlighting the ionised Universe by uncovering the faintest ever host galaxy of a Fast Radio Burst

Mon May 19 13:00:09 GMT 2025

Observation	<p>Proposal 5743, Observation 2: NIRSpec spectroscopy of host</p> <p>Diagnostic Status: Warning</p> <p>Observing Template: NIRSpec Fixed Slit Spectroscopy</p> <p><i>Comments: This NIRSpec observation will follow a similar technique to NIRSpec/MSA pre imaging. Once the NIRCAM imaging is complete and the host is identified, the NIRSpec TA + observations can be planned.</i></p>																																											
Diagnostics	(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.																																											
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Proposal 5743 - Observation 2 - Spotlighting the ionised Universe by uncovering the faintest ever host galaxy of a Fast Radio Burst

Special Requirements

Aperture PA Range 21.84190369 to 55.84190369 Degrees (V3 243.0 to 277.0)
Aperture PA Range 171.84190369 to 181.84190369 Degrees (V3 33.0 to 43.0)
Aperture PA Range 201.84190369 to 208.84190369 Degrees (V3 63.0 to 70.0)